ATP Evaluation "Toolkit" Project

Models, Methods, and Findings

Rosalie Ruegg, Managing Director, TIA Consulting, Inc.

Irwin Feller, Senior Visiting Scientist, AAAS and Prof. Emeritus, Penn State University

Connie Chang, ATP COTR

ATP Advisory Committee Meeting

Presentation Outline

- Project Purpose – Connie Chang
- Key Findings – Rosalie Ruegg
- Conclusions & Recommendations – Irwin Feller
- Q & A

ATP'S Assessment Program

- Began early
  - -before GPRA, 1993
  - -before President's Management Agenda, 2001
- Contributes to improved understanding of public-private R&D partnerships and how they work best

ATP Evaluation "Toolkit" Project

Purpose: To provide a compilation of evaluation tools and methodologies, and crosscutting analysis of ATP's impacts.

Scope: Examined 45 studies commissioned over ATP's first decade.

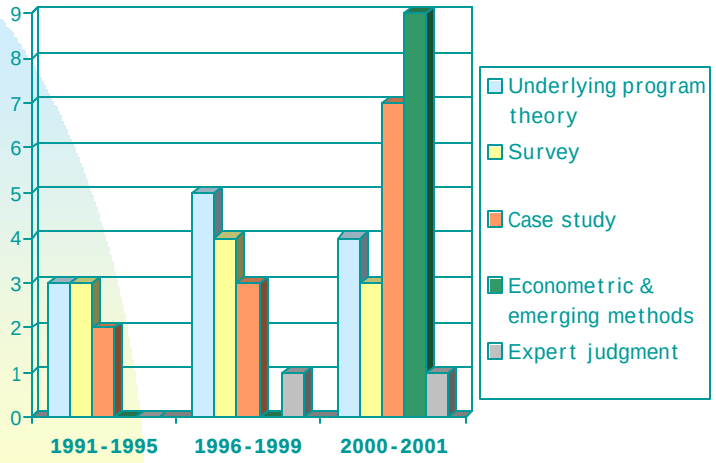
ATP Has Been Evaluated …

- from multiple methodological perspectives
- by a large number of independent researchers and nationally regarded institutions

Evaluation Methods

- Modeling underlying program theory
- Survey
- Case study
  - Descriptive
  - Economic estimation
- Econometric/statistical analysis
- Sociometric/social network analysis
- Bibliometrics
  - Counts
  - Citations
  - Content analysis
- Historical tracing
- Expert judgment
- Other methods

ATP's Evolving Use of Methods



Analysis of 45 ATP Studies by Topic

- Modeling Underlying Program Theory (26 studies)
- Impacts on Private Firms (13 studies)
- Collaboration (10 studies)
- Spillover effects (10 studies)
- State and Foreign programs (5 studies)
- Overall ATP performance measures (13 studies)

Summary of Crosscutting Findings

Considerable evidence that ATP is achieving its overarching objectives:

- Increased rates of innovation
- Broadly enabling technology platforms
- Commercialization by U.S. companies
- Improved competitiveness of U.S. industries
- Broadly distributed economic benefits from large spillovers
- Increased collaborations
- Strong small business participation
- ATP a strong causal factor—leveraging, not substituting

10 Recommendations for Further Evaluation

1. Increase market-data–based analyses
2. Incorporate direct- and indirect-path analysis in benefit-cost case study
3. Continue/extend status reports of completed projects
4. Update information on state and foreign programs
5. Develop promising new evaluation techniques
6. Deepen knowledge-spillover analysis
7. Address new questions as ATP is modified
8. Pursue analysis of failures and successes
9. Continue an effective mix of in-house and external evaluation studies
10. Take greater advantage of evaluation results in decision-making processes

Ways ATP Has Benefited from Evaluation

- Evaluation has permitted ATP to provide a full response to critics who say
  - it doesn't work
  - it hasn't been tested
- Evaluation has addressed foundational issues showing ATP is needed
- Evaluation has provided (and is providing) a growing body of documented evidence that ATP is accomplishing its core objectives

Evaluation is Important for Public Programs

An agency's ability to demonstrate that it has:

- A plan and organizational capacity to conduct such assessment;
- An explicit set of performance metrics;
- An organizational commitment to evaluate its performance; and
- Credible results

are important elements in annual budget reviews by the executive and legislative branches and important political and budgetary markers.

Evaluation in a Political Context

Clearly, evaluation is necessary to a public program…

but is it sufficient?

Reference Slides on Evaluation Methods

Survey

Collecting information for tabulation and analysis from multiple parties based on a uniform set of questions

- Advantages
  - relatively fast and economical
  - accommodates use of control & comparison groups
  - accommodates qualitative & quantitative data
  - understandable by diverse audiences
  - high perceived credibility
- Disadvantages
  - does not convey richness of project story
  - data may be difficult to verify
  - results may be influenced by context, timing, and other circumstances
  - response rate
  - confidentiality/proprietary nature of data

Case Study: Descriptive

Narrative approach used to describe a real example

- Advantages
  - tends to be memorable and quotable
  - richness of detail may be useful in formulating theories and hypotheses
  - can serve as a benchmark
- Disadvantages
  - "for example" is not proof (anecdotal nature of findings not necessarily persuasive)
  - of limited use for generalizing results (unless replicated many times with tabulation of key information compiled using a common template)

Case Study: Economic Estimation

Descriptive narrative plus benefit-cost estimation

- Advantages
  - focus on impacts rather than outputs
  - scope extends from project start to finish
  - quantitative results that tend to have relatively high credibility
  - provides measures in the language of finance which facilitates comparisons
- Disadvantages
  - not all important benefits can be estimated in monetary terms
  - differences between social, private, and public benefits may not be understood
  - empirical estimation requires substantial passage of time
  - difficult to acquire data

Econometric/Statistical Analysis

Estimating economic relationships by applying mathematical models to structure the relationships, and by applying statistical methods to analyze economic data, estimate parameters, and interpret the strength of evidence for hypotheses examined

- Advantages
  - adds to analytical capability of evaluators
  - contributes to understanding causal relationships between inputs and outputs in the face of complex and imperfect data
  - provides quantitative results
- Disadvantages
  - often difficult for non-specialists to understand and communicate
  - not all important effects can be captured
  - imperfect and variable in how well they capture target relationships
  - data intensive needs

Sociometric/Social Network Analysis

Study of how networks of interpersonal relationships emerge, evolve, and affect economic behavior

- Advantages
  - reflects growing awareness that social networks affect economic behavior and outcomes
  - spillover effects may be especially influenced by social networks
  - provides an alternative perspective focused on human and institutional dimensions
- Disadvantages
  - may be less familiar to economists, program administrators, and policy makers
  - does not provide quantitative measures of economic impact

Bibliometrics

Counting – tracking quantity of publications and patents
Citation analysis – tracking pathways of knowledge dissemination
Content analysis – extracting content, patterns, and relationships from text and "data warehouses"

- Advantages
  - widely applicable to programs that generate knowledge
  - reveals movement in a field of research or technology
  - shows relational linkages
  - can indicate conversion of research findings to technology
  - doesn't require cooperation of subjects
  - diverse audiences can understand
- Disadvantages
  - findings are not necessarily central to stakeholder objectives (i.e., takes into account only publications and patents)
  - specific problems in application

Historical Tracing

Emphasizes tracing chronologically a series of interrelated developments leading from research to outcome, or from outcome back to the factors that spawned them

- Advantages
  - provides linkages all the way from inputs to outcomes
  - sheds light on process dynamics
  - interesting and relatively credible results
  - useful in combination with other methods
- Disadvantages
  - multiple, complex relationships may cloud significance of linkages
  - evolving pathways and dead ends can stymie forward tracing
  - disconnects can frustrate backward tracing
  - vulnerable to criticism of lack of counterfactual

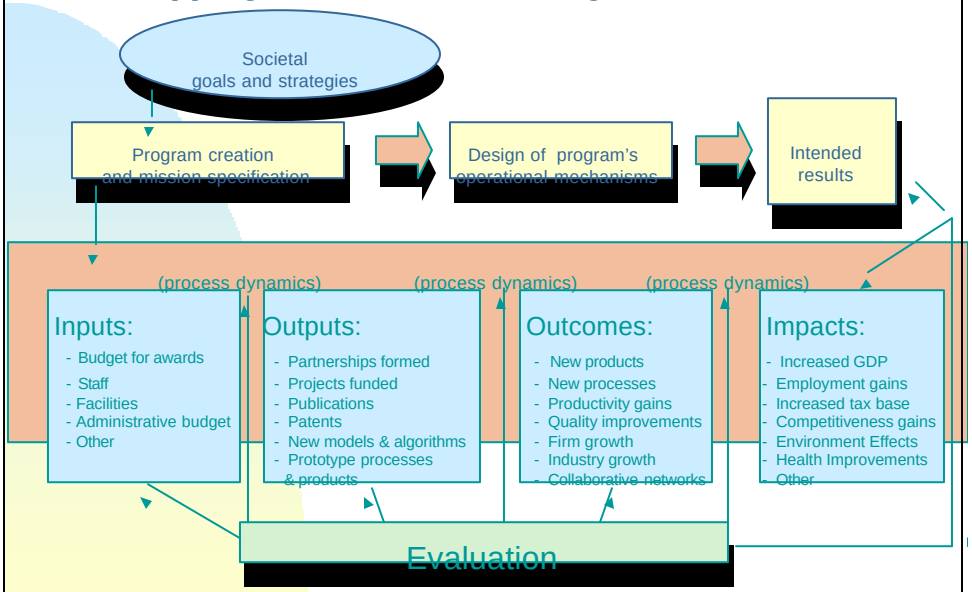
Expert Judgment

Opinion based on training and experience and informed by reviewing written or orally presented evidence or by directly observing activities and results

- Advantages
  - practical – a relatively quick, feasible, widely accepted approach
  - offers chance for interchange of ideas/perspectives
- Disadvantages
  - more suitable for formative evaluation with its focus on current activities than for summative evaluation with its focus on impact assessment
  - requirement for qualified reviewers free of bias and conflict of interest

Backup Slides

Mapping Evaluation to Program Mission



5 Central Questions

- Has ATP assisted U.S. businesses, including small businesses, to accelerate development and commercialization of high-risk, enabling technologies?
- Has ATP fostered collaboration among firms, universities, and other organizations, and with what impact?
- Has ATP added to the nation's scientific and technical knowledge base?
- Has ATP helped to refine manufacturing practices and improve the competitiveness of U.S. industry?
- Has ATP generated knowledge and market spillovers leading to broad-based economic benefits and social returns substantially in excess of private returns?

Conceptual Tests of ATP's Success

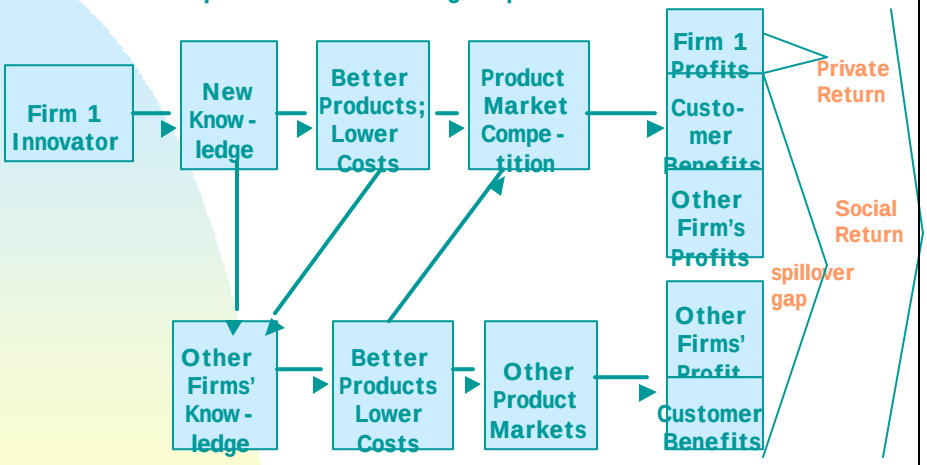
- **Test 1**: Has the portfolio of ATP-funded projects produced large net social benefits for the nation?
- **Test 2**: Has the portfolio of ATP- funded projects contributed to enhanced United States economic and technological competitiveness?
- **Test 3**: If test 1 is met, is a large share of the benefits attributable to ATP?
- **Test 4**: Regarding the distribution of net benefits, do they extend well beyond the direct ATP award recipients?

Analysis of 45 ATP Studies by Topic

- Modeling Underlying Program Theory (26 studies)
- Impacts on Private Firms (13 studies)
  - Financing gap - Halo effect - Acceleration - Firm Productivity - Small Firm Participation - Commercialization - Company growth - Private returns
- Collaboration (10 studies)
  - Activity - Structure - Formation - Attribution - Changes in relationships - University representation and roles - Determinants of success - Benefits and Costs
- Spillover effects (10 studies)
  - Market spillovers - Knowledge spillovers
- State and Foreign programs (5 studies)
  - State program interfaces - Foreign program comparisons
- Overall ATP performance measures (13 studies)
  - ATP's contribution - Improving competitiveness - Improving national capacity of innovate - Dealing with failed projects - Indicators of progress - Social benefits - Overall effectiveness

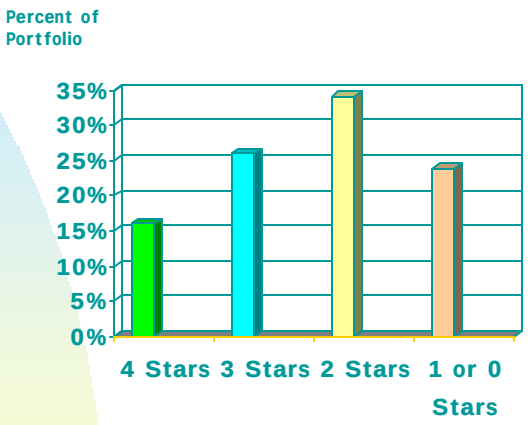
Spillover Mechanism

Market Spillovers + Knowledge Spillovers + Their Interaction:



[Jaffe]

Composite Performance Ratings of 50 Completed ATP Projects



[Ruegg, NRC, and ATP Status Report #2]

Evaluation Challenges

- Difficulties of Measurement
  - public vs. private returns
  - time dimension
  - resistance
- Clarity and Understandability
  - presenting to target audiences
- Credibility
  - independent
  - robust
  - scope
- Effectiveness
  - logical evidence vs. philosophical/political views
  - making sense of an eclectic approach